Ordering number : EN 2927

Monolithic Linear IC

No.2927

LA7555

IF Signal Processing (VIF + SIF) Circuit for TV / VCR Use

The LA7555 is a full sync detection method VIF + SIF monolithic linear IC using a PLL. It has excellent 920kHz beat and buzz beat characteristics, making it ideal for use in audio multiplexing and high-quality AV equipment.

Functions

- VIF Section
  - VIF amp
  - Video sync detection
  - IF AGC
  - B/W NC
  - RF AGC
  - AFT
  - VCO
  - APC DET
  - Lock DET
- SIF Section
  - SIF limiter amp
  - FM quadrature detection
- Audio Section
  - DC attenuator
  - AF driver
- Muting
  - Audio muting (pin 2)
  - Audio-Video simultaneous muting (pins 10,13)
  - AFT defeat (pin 14)

Features

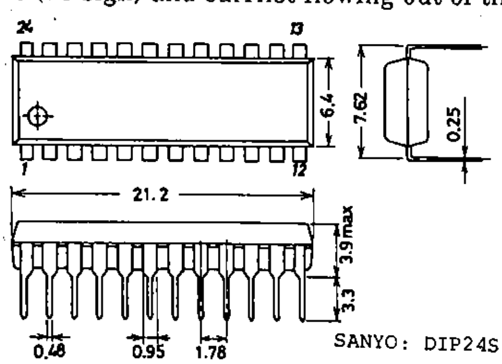
- 24-pin DIP shrink package being the smallest one used for PLL ICs
- Excellent 920kHz beat characteristics
- Excellent buzz beat characteristics
- High-gain VIF amp
- High-speed AGC possible
- Excellent power supply ripple characteristics

Maximum Ratings at Ta = 25°C

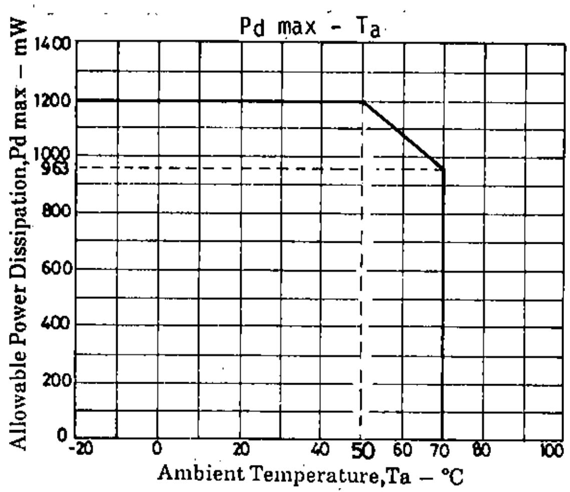
				unit
Maximum Supply Voltage	V_{CC} max		13.8	V
Allowable Power Dissipation	Pd max	Ta≦50°C	1200	mW
Operating Temperature	Topr		−20 to +70	°C
Storage Temperature	Tstg		−55 to +150	°C
Circuit Voltage	V_{12},V_{13}		V_{CC}	V
	V_{16}		V_{CC}	V
	V_{22}		V_{CC}	V
	V_{23}		V_{CC}	V
Circuit Current	I_5		−3	mA
	I_{21}		−5	mA
	I_{22}		2	mA

Note: Assumes that the current flowing into the IC is positive (no sign) and currnet flowing out of the IC is negative.

Package Dimensions
(unit :mm)
3067



SANYO Electric Co., Ltd. Semiconductor Business Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN



Operating Conditions at Ta = 25°C

			unit
Recommended Supply Voltage	V_{CC}	12	V
Operating Voltage Range	V_{CC} op	10 to 13.2	V

Operating Characteristics at Ta = 25°C

[VIF Section]			Test Point	min	typ	max	unit
Circuit Current	I_6+I_{17}	V_{13}=11V	Pins6,17	45	57	71	mA
Quiescent Video Output Voltage	V_{21}	V_{13}=11V	Pin21	5.9	6.3	6.7	V
Maximum RF AGC Voltage	V_{11H}	V_{13}=11V	Pin11	10.6	11	11.4	V
Minimum RF AGC Voltage	V_{11L}	V_{13}=11V	Pin11		0	0.5	V
Quiescent AFT Output Voltage	V_{16}	V_{13}=11V	Ⓑ	3.5	6.5	7.5	V
Input Sensitivity	Vi	f_m=400Hz,40% AM	Ⓐ	33	39	45	dB/μV
AGC Range	GR		Ⓐ	60	65		dB
Maximum Allowable Input	Vi max		Ⓐ	100	200		mVrms
Video Output Amplitude	Vo(video)	f_m=15kHz,78% AM	Ⓐ	1.9	2.2	2.5	Vp-p
Output S/N	S/N	Vi=10mV,CW	Ⓐ	49	53		dB
Sync Signal Tip Voltage	V_{21} tip	Vi=10mV,CW	Ⓐ	3.45	3.7	3.95	V
920kHz Beat Level	I_{920}	P=0 C=–4dB, S=–14dB (2Vp-p)	Ⓐ	38	46		dB
Frequency Characteristic	f_c	P=0,S=–14dB	Ⓐ	6	7		MHz
SIF Output Signal Voltage	Vo (SIF)	P=0,S=–20dB	Ⓐ	110	180	260	mVrms
Differential Gain	DG	fp=58.75MHz, Vi=10mV,mod 87.5%, video signal	Ⓐ		3	8	%
Differential Phase	DP	fp=58.75MHz, Vi=10mV,mod 87.5%, video signal	Ⓐ		3	8	deg
White Noise Threshold Voltage	V_{WTH}		Ⓐ	6.4	6.8	7.2	V
White Noise Clamp Voltage	V_{WCL}		Ⓐ	4.2	4.6	5.0	V
Black Noise Threshold Voltage	V_{BTH}		Ⓐ	2.3	2.6	2.9	V
Black Noise Clamp Voltage	V_{BCL}		Ⓐ	4.1	4.5	4.9	V
Maximum AFT Voltage	V_{16H}	Vi=10mV,SWEEP	Ⓑ	11.0	11.5	12.0	V
Minimum AFT Voltage	V_{16L}	Vi=10mV,SWEEP	Ⓑ	0	0.5	1.0	V
AFT Detection Sensitivity	S_f		Ⓑ	37	50	70	mV/kHz
Input Resistance	r_i	f=58.75MHz		0.8	1.3	1.75	kΩ
Input Capacity	c_i	f=58.75MHz			3.0	6.0	pF
APC Pull-in Range (U) 1	$f_{PU\text{-}1}$		Ⓐ		0.8		MHz
APC Pull-in Range (L) 1	$f_{PL\text{-}1}$		Ⓐ		–0.8		MHz
APC Pull-in Range (U) 2	$f_{PU\text{-}2}$		Ⓐ		2		MHz
APC Pull-in Range (L) 2	$f_{PL\text{-}2}$		Ⓐ		–2		MHz

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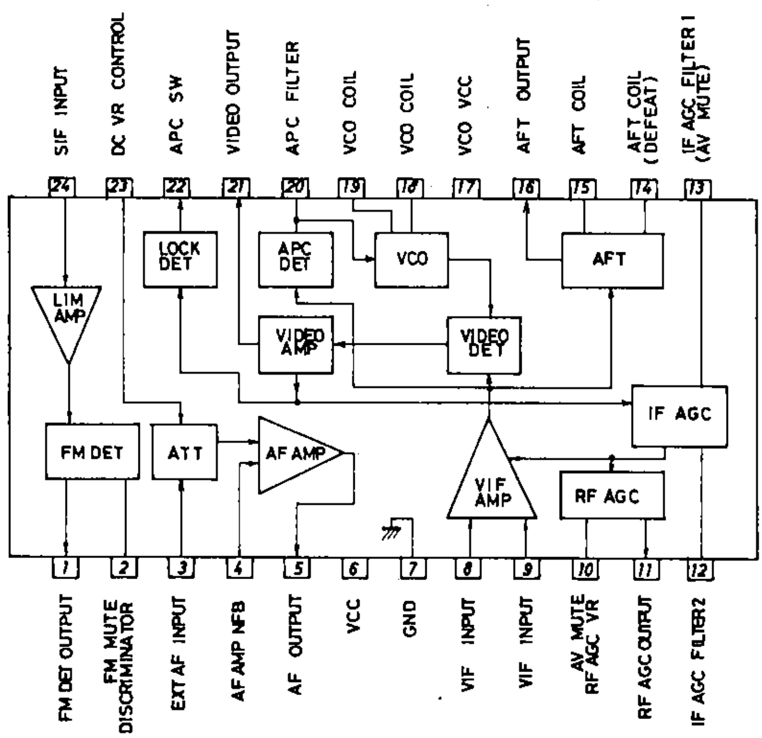
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			Test Point	min	typ	max	unit
Lock Detection Threshold Voltage	V_{13TH}		Pin22	11	11.5		V
VCO Maximum Variable Range	Δf_U	$V_{20}=3V$	Ⓐ		2.1		MHz
VCO Maximum Variable Range	Δf_L	$V_{20}=7V$	Ⓐ		−2.1		MHz
VCO Control Sensitivity	β	$V_{20}=5V$ to 4.6V	Ⓐ	1.4	2.8	5.6	kHz/mV
[SIF Section]							
SIF Limiting Voltage	Vi (lim)	$V_{13}=5V$	Ⓒ		160	320	μVrms
FM Detection Output Voltage	Vo	$V_{13}=5V$	Ⓒ	−5.3	−1.8	+0.4	dBs*
AM Rejection	AMR	$V_{13}=5V$	Ⓒ	40	55		dB
Distortion	THD (Det)	$V_{13}=5V$	Ⓒ		0.5	1	%
[Audio Section]							
DC VR Maximum Attenuation	A_{TT}	$V_{23}=8V\rightarrow 0V, V_{13}=5V$	Ⓓ	70	75		dB
AF Amp Voltage Gain	G_{AF}	$V_{23}=8V, V_{13}=5V$	Ⓓ	18	20	22	dB
AF Amp Distortion	THD (AF)	$V_{23}=8V, V_{13}=5V$, f=400Hz	Ⓓ		0.5	1	%
AF Amp Maximum Output Voltage	Vo max (AF)	$V_{23}=8V, V_{13}=5V$	Ⓓ	3	4		Vrms

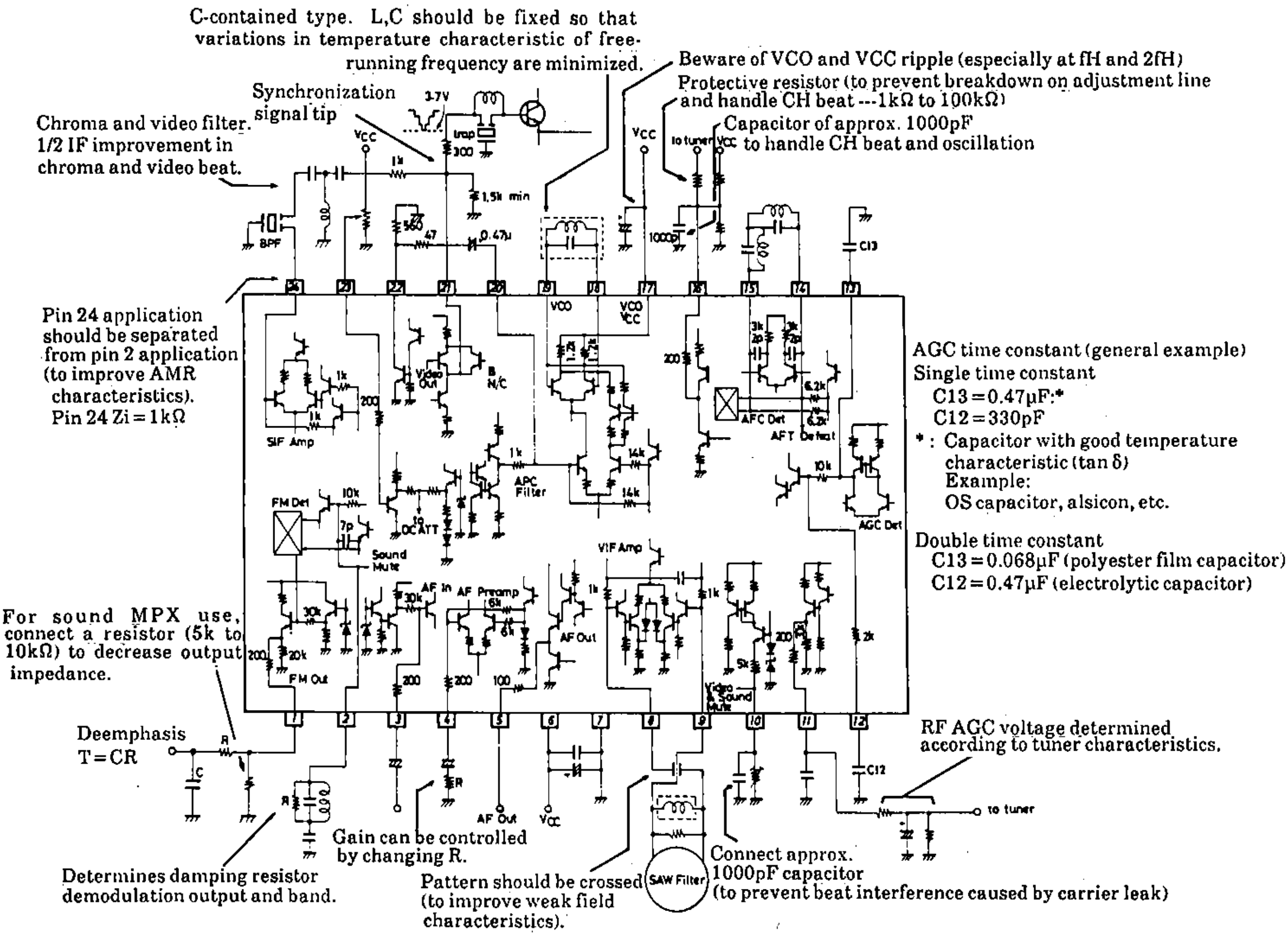
*: 0dBs=0.7745Vrms

Ⓐ : Video output (pin21), Ⓑ : AFT output (pin16), Ⓒ : FM detection output (pin1), Ⓐ : Audio output (pin 5)

Equivalent Circuit Block Diagram



Precoutions when using the LA7555



Unit (resistance:Ω, capacitance:F)

Description of Operation

1. IF amp

As shown in Fig.1-1, the IF amp consists of three amplifiers directly connected with balanced input. Amps 1, 2 and 3, and the gain are controlled by the AGC.

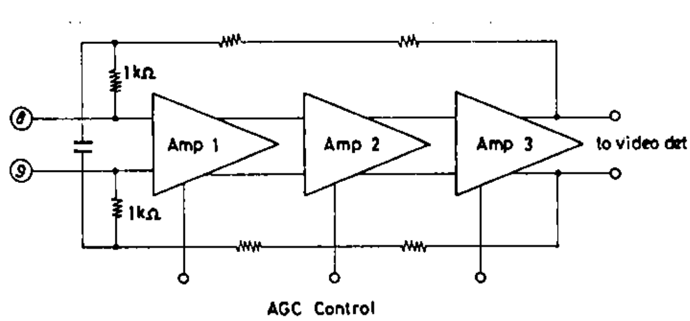


Fig.1-1

2. Video detector

As shown in Fig.2-1, the video detector is a PLL-type. AM detection (video detection) is by phase shifting the IF signal and VCO output signal 180° and multiplying the input signal. It offers excellent buzz and beat characteristics as detection is by multiplication by a clean signal. Also, excellent detection characteristics are obtained in the same manner for the overmodulation signal.

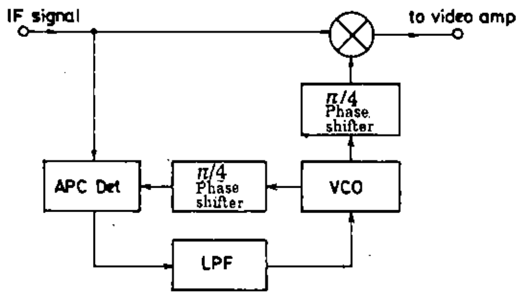


Fig.2-1

3. Video amp B/W noise canceller

As shown in Fig.3-1, the video amp amplifies the detection output voltage over a wide band to the desired voltage (=2.2Vp-p). The amplified video signal passes through the B/W noise canceller and is output to pin 21.

White: The noise canceller operates as shown in Fig.3-3 as the input of noise exceeding the white level of the video signal as shown in Fig.3-2 will cause noticeable noise on the screen.

Black: The noise canceller operates as shown in Fig.3-3 as the input of noise exceeding the sync signal tip as shown in Fig.3-2 will prevent proper operation of the next-stage sync separation circuit.

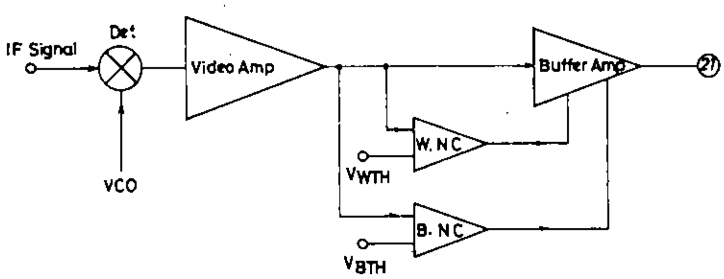


Fig.3-1

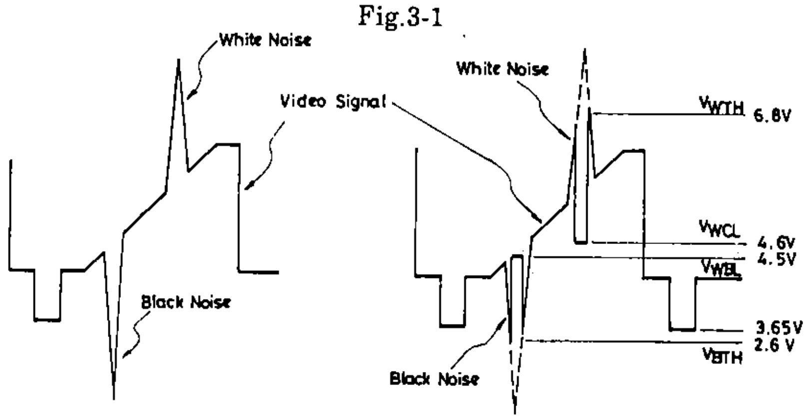


Fig.3-2 Fig.3-3

4. Lock detector

As shown in Fig.4-1, the lock detector is an APC time constant switching detection circuit which expands the APC pull-in range. The detection circuit operates by the OR of the IF AGC voltage and the video signal. The weak field is detected by the IF AGC voltage and the unlock state when detuned is detected from the video signal.

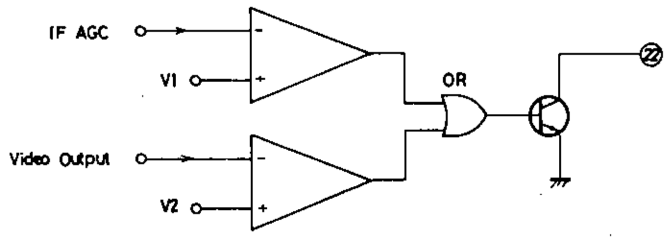


Fig.4-1

5. AGC detector

As shown in Fig.5-1, the AGC detector is equipped with a noise canceller function which prevents malfunction of the AGC system. The AGC detection output (pin 13) is also used for video output, FM detection output, and as the simultaneous mute (AV MUTE) pin.

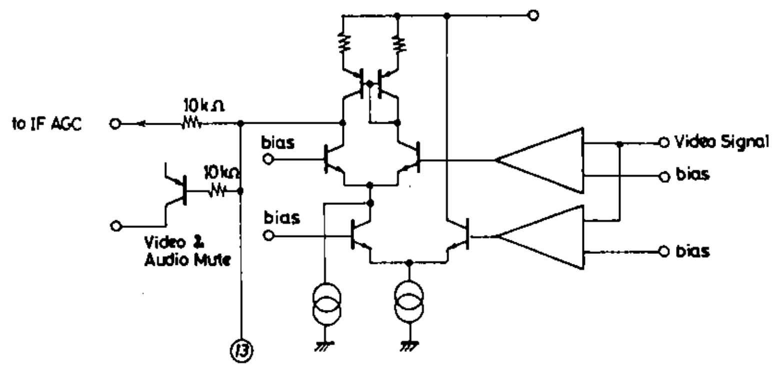


Fig.5-1

6. RF AGC

As shown in Fig.6-1, the RF AGC controls the gain of the tuner's RF amp. Measurement is made whether the region is snow region (noise on the screen, poor S/N ratio) or a saturation region (contours can be clearly seen but look bad due to video signal distortion), and the RF AGC delay point is set as shown in Fig.6-2. Pin 10 is also used for video output, FM detection output, and as the simultaneous mute (AV MUTE) pin.

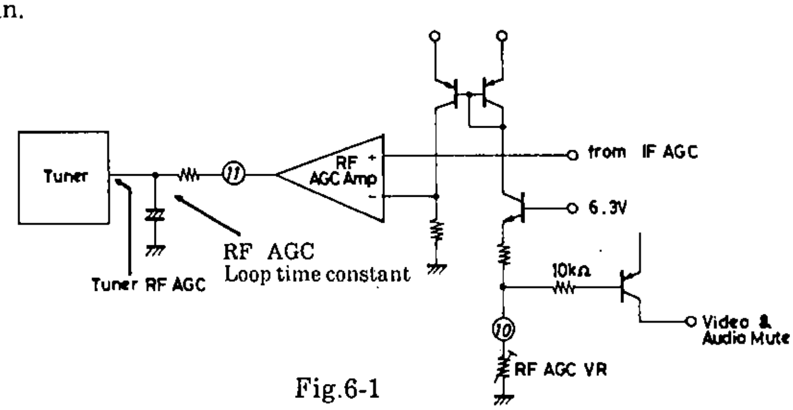


Fig.6-1

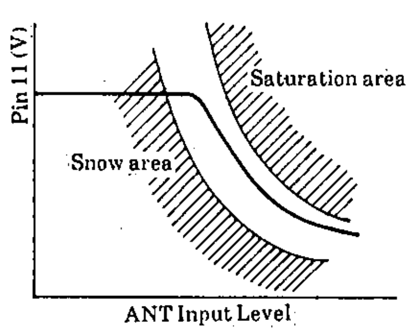


Fig.6-2

7. AFT

As shown in Fig.7-1, the AFT is a balanced-type using a quadrature detection circuit. The input signal is shifted 90° by the internal capacitor and external phase shifter, and quadrature-detected. Pin 14 is also used as the AFT Defeat pin. Fig.7-1

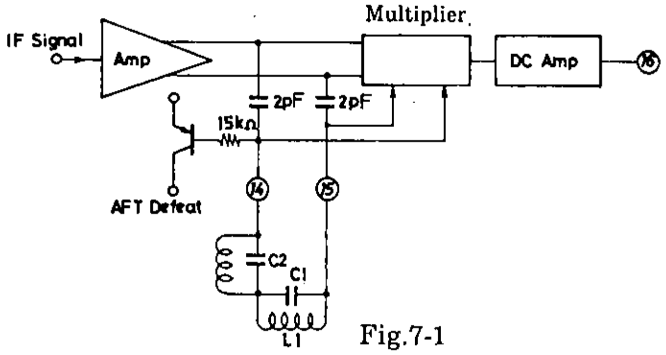


Fig.7-1

C2 forms a sound trap for preventing malfunction of the AFT.

8. SIF limiting amp

As shown in Fig.8-1, the SIF limiting amp is an unbalanced limiting amp consisting of four stages directly connected. There is negative feedback within the IC to balance the differential amplifier.

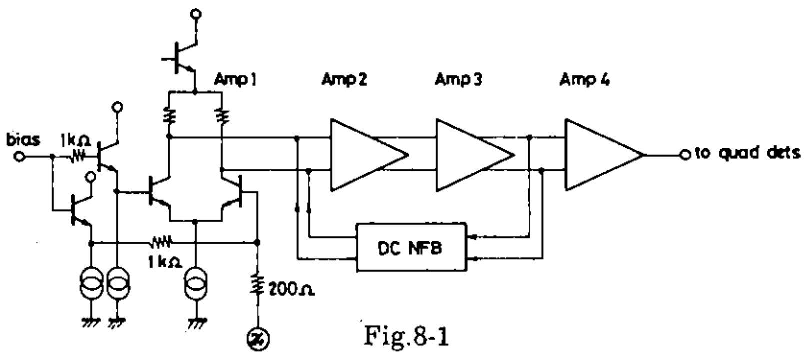


Fig.8-1

9. Quadrature detection

SIF quadrature detection is by the single pin detector with internal phase shift capacitor, shown in Fig.9-1. FM detection is by shifting the SIF signal 90° and multiplying it. The characteristics of the phase shifting circuit are as follows:

1. Demodulation output...mainly Q_L
2. Distortion...linearity of phase shifting circuit, symmetry of S curve

The linearity of the phase shifting circuit can be improved by lowering Q_L and increasing the band with a single-tuned circuit, but the FM detection output will drop.

Pin 2 is also used as the SIF mute pin.

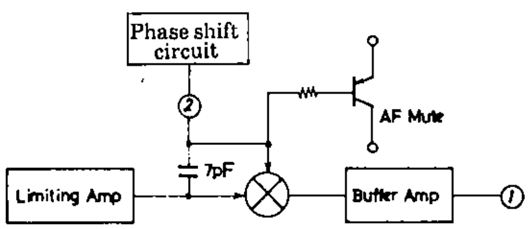


Fig.9-1

10. Electronic volume control

As shown in Fig.10-1, this is an electronic volume control, having a control pin with high input impedance. The attenuation curve is a logarithmic curve. The external audio input impedance is approximately 30kΩ.

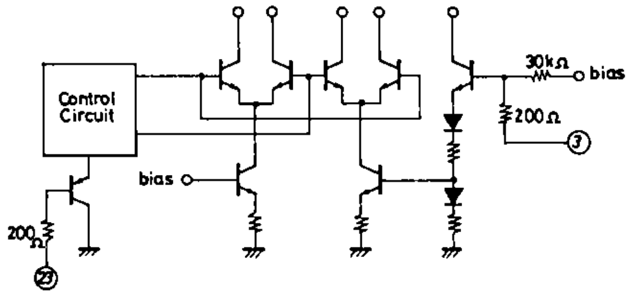


Fig.10-1

11. AF amp

As shown in Fig.11-1, this is an AF amp equipped with an NFB pin. An audio power amp can be easily configured by use of this NFB pin. The gain of the power amp can be controlled by the ratio of R1 and R2.

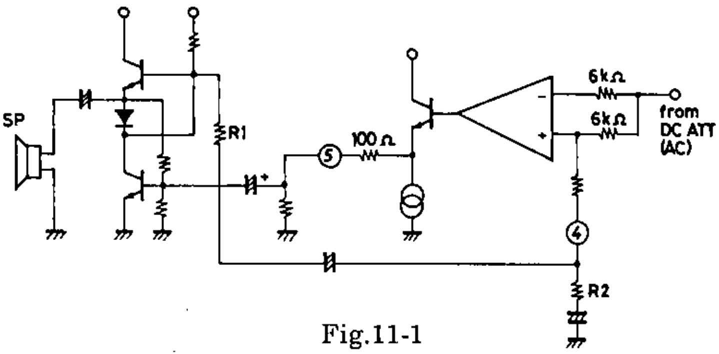


Fig.11-1

VCO adjustment methods

The following two methods are available for adjusting the VCO.

1. APC voltage offset adjustment method
   a. Connect a digital voltmeter to pin 20 (APC filter pin) (Fig.1).
   b. Lower the IF input level and connect the IF AGC (pin 13) to GND. Measure the voltage on pin 20 at this time.
   c. Raise the IF input level to the desired value. Free the IF AGC from GND (internal AGC). Adjust the VCO so that the voltage (V2) on pin 20 is equal to V1.

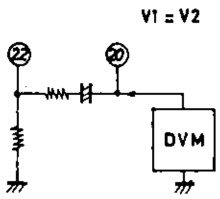
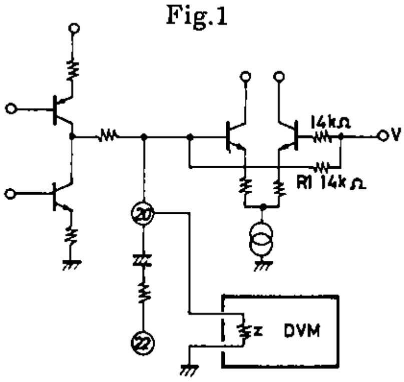


Fig.1



Note: When adjusting by this method, use a DVM (digital voltmeter) with high input impedance. At Zi = 10MΩ, the adjustment error is approximately 20kHz. The error (ΔV) with the DVM connected is

$$\Delta V(mV) = V\left(1 - \frac{R_1}{Z + R_1}\right)$$

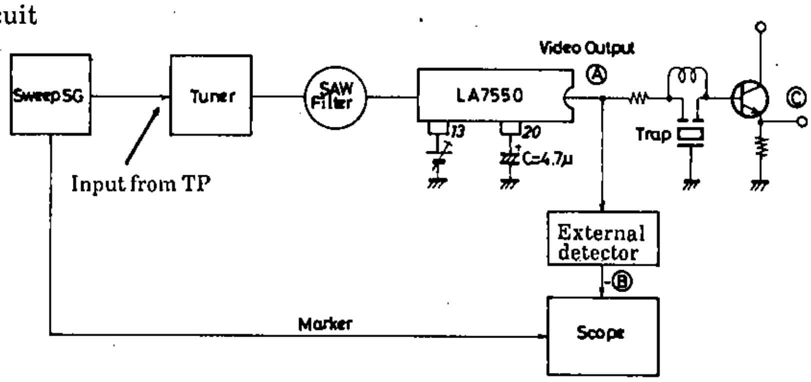
The change in VCO free-running frequency (Δf) according to ΔV is Δf(kHz) = ΔV × β.
where β = VCO control sensitivity (kHz/mV)

2. Direct reading method
   a. Lower the IF input level and adjust the IF AGC (pin 13) to between GND and about 4V (VCO free run).
   b. Monitor the carrier frequency leaking from pins other than the VCO coil, or pattern, chassis, and adjust the VCO coil to obtain the desired frequency (fp).

Measurement of VIF selectivity characteristics

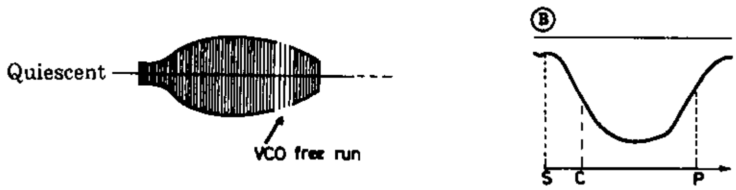
The pull-in range of the PLL-type VIF IC is approximately ±2MHz. Thus, it is not possible to measure the matching characteristics of the tuner SAW filter easily as with the dummy synchronization detection method. The following is just one example of how to measure the selectivity characteristics for a single signal.

Test Circuit



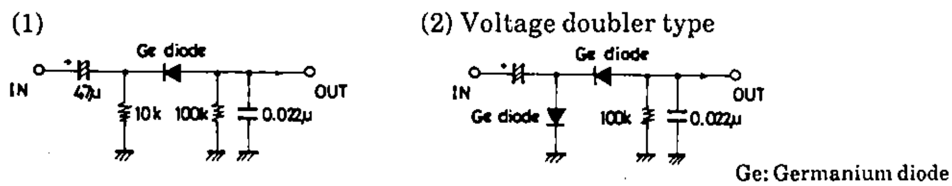
Conditions

1. Apply voltage to the IF AGC (pin 13) and adjust until the video output Ⓐ is 0.5Vp-p.
2. Attach a 4.7μF capacitor to the APC filter (pin20) so that the PLL is unlocked.
3. The waveform shown in the diagram below can be monitored through the externally mounted detector.



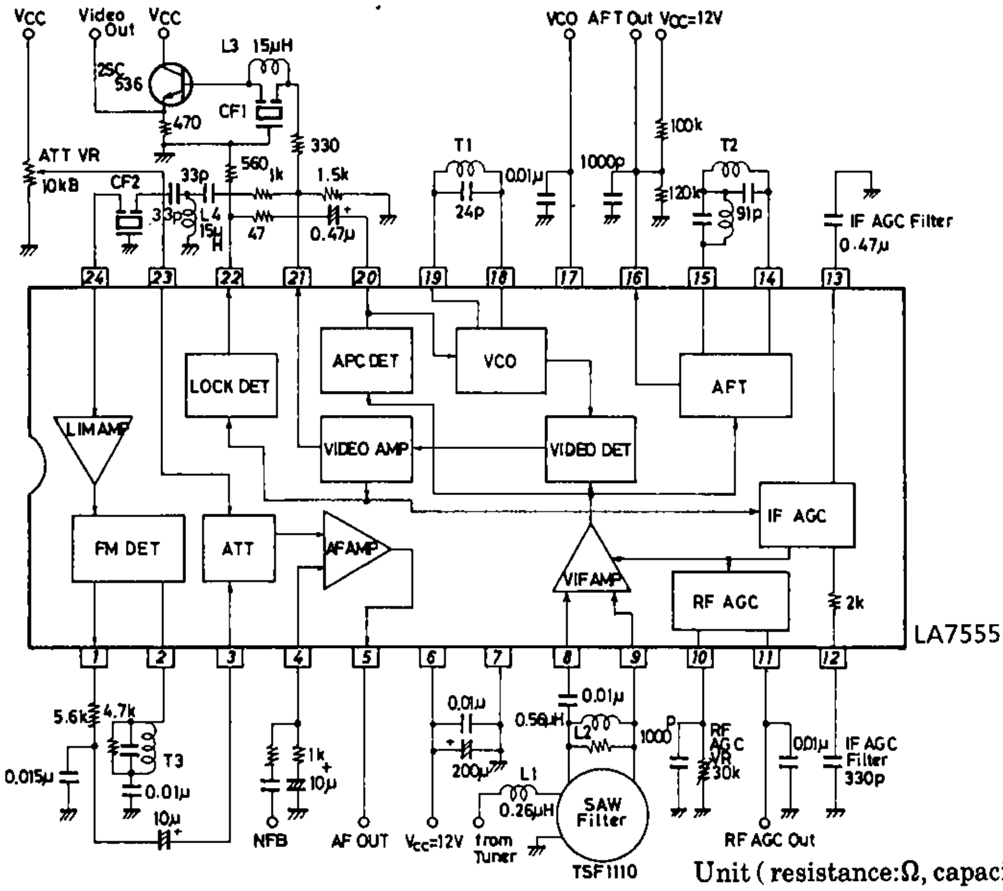
Note: Error will occur in the measurement of the selectivity characteristics if the video frequency changes between Ⓐ and Ⓒ (by a video equalizer, etc.).

Externally Mounted Detector (Example)

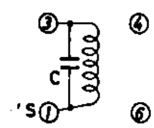
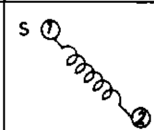
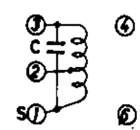
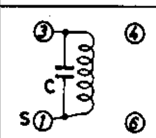
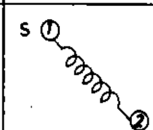
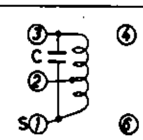
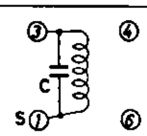
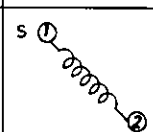


Unit (resistance:Ω, capacitance:F)

Sample Application Circuit (JAPAN)



Unit (resistance:Ω, capacitance:F)

Item	T1: VCO coil	T2: AFT coil	T3: SIF coil	SW filter
JAPAN f_p=58.75MHz	 7mm square 0.12Φ 6t C=24pF PH S-CORE HW-6226-4 MITSUMI	 7mm square 0.5Φ 3 1/2t External c=91pF MA-6342 MITSUMI	 7mm square 0.08Φ 19t - 19t C=100pF KS-6102-1 MITSUMI	SAW Filter TSF1110 SANYO
US f_p=45.75MHz	 7mm square 0.12Φ 9t C=24pF PH S-CORE HW-6227-4 MITSUMI	 7mm square 0.5Φ 5 1/2t External c=91pF MA-6343 MITSUMI	 7mm square 0.08Φ 19t - 19t C=100pF KS-6102-1 MITSUMI	SAW Filter TSF1203 SANYO TSF1212 SANYO
PAL f_p=38.9MHZ	 7mm square 0.12Φ 11t C=24pF PH S-CORE MA-6389 MITSUMI	 7mm square 0.5Φ 6 1/2t External c=91pF MA-7115 MITSUMI		SAW Filter TSF1303 SANYO